RÉPUBLIQUE FRANÇAISE

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CENTRE NATIONAL D'ÉTUDES SPATIALES

PROGRAMMES & PERSPECTIVES

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FOREWORD

PHILIPPE BAPTISTE

CNES CHAIRMAN & CEO

The Prime Minister announced major investments in space and the ESA Ministerial Conference at the end of last year was a huge success. Does this promise great things in store for CNES?

Investments announced augur extremely well for space in France and Europe.
With its strong contribution to ESA, France is making its voice heard and we're launching fundamental projects like the IRIS² secure satellite constellation with the European Commission, the modernization of the Guiana Space Centre and major investments in Earth-observation programmes.
Besides France's participation in ESA programmes, we'll also be able to commit to missions eagerly awaited by the scientific community, like for example AOS with Japan and the United States.
So, we have plenty of work on our plate at CNES, which is a true sign of recognition and a great vote of confidence in our talents and expertise.

With the France 2030 plan, France is clearly embracing New Space. What is CNES's role in this new ecosystem?

Our role is absolutely key, working with public investment bank Bpifrance to identify topics and operate the space strand of France 2030. Entrepreneurs are also very keen to tap into our extraordinary technical expertise. We need to envision win-win partnerships where firms looking to up their game can do so very quickly and in return we benefit from new services and tools in the future. That's one way of doing things, but there are many others; we won't be able to work with everybody. There also have to be clear rules and regulations. These are exciting times for our agency and it's a new mission for us. CNES is a pivotal player in New Space, and we have the skills and resources to make France a champion.

With Ariane 6 on the way and Space Command (CDE) ramping up at the Toulouse Space Centre, the sovereignty stakes for CNES and spacefaring Europe are high. Can you tell us more about that?

Space sovereignty has never been so crucial and its importance is recognized across all of Europe. The military stakes are multiple. We still face key challenges like positioning, intelligence, observation and secure communications, as we always have; but today, space has also become a theatre for conflict. That's why the CDE is ramping up and its strategy is perfectly aligned with CNES's. With regard to launchers, all of spacefaring Europe is eagerly awaiting Ariane 6, as access to space is fundamental.

France has underlined its commitment to climate science, notably upping its ESA contribution to Earth observation by 26%. What does this mean for CNES?

Our increased contribution to ESA will give us a major role in the FutureEO programme's large-scale Earth-observation missions.
We're also investing a lot in multilateral missions through CNES's medium-term plan. These obviously include SWOT, from which we're awaiting the first results, AOS and other missions soon to be announced. Our commitment is vital, as satellite data help scientists to gain insights into Earth's current climate and develop models to forecast what it will be like in the future.

Some fine space exploration missions are set for launch in partnership with other space agencies. What is CNES's involvement?

CNES is supplying instruments and a reliable launch base and launcher. I would like to highlight two missions: the French-Chinese SVOM mission and the French-German-Japanese MMX mission, which in particular will be fielding a highly innovative small rover built in record time with the German space agency DLR. We're very proud to be playing a key role in these missions, which we obviously owe to our strong partnership ties with other space agencies. To mention just one, CNES's collaboration with NASA is solid and founded on deep mutual respect. Space cooperation is a very powerful tool with ramifications for science, international reach and diplomacy.
I would like to conclude with a word about European human spaceflight. Last year, President Emmanuel Macron mandated ESA to set up a working group on this topic.
In the coming months, Europe's governments are going to have to decide together whether to continue along this path.

SUPPORTING FRENCH SPACE STRATEGY

To support the national space strategy set out by President Emmanuel Macron, Prime Minister Elisabeth Borne announced major investments in her speech to the International Astronautical Congress (IAC) in Paris in September 2022.

" In total, France is poised to invest **more than €9 BILLION** in space over the next three years, for research and our space industry."

This represents an increase of nearly 25% over the previous three-year period.
With this new injection of funding for the space sector, CNES will be able more than ever to consolidate its key role in maintaining France and Europe's position as world leaders in space.

French space in short:

NEARLY €11 BILLION
IN REVENUES FROM SPACE INDUSTRY MANUFACTURING

70,000
JOBS ACROSS THE ECOSYSTEM

1,700
FIRMS

"We want these major investments to have maximum impact for our research, our industry and our fellow citizens."
Elisabeth Borne, Prime Minister.

REAFFIRMED EUROPEAN SPACE AMBITIONS

The ESA Ministerial Conference held on 22 and 23 November 2022 in Paris was a huge success for Europe's space programme, securing an exceptional budget envelope of **€16.9 BILLION** for the next three years. This record budget represents a 17% increase over that allocated by the previous ESA Ministerial Conference in 2019.

Among the standouts of this conference, independent access to space was confirmed as key to sustaining Europe's sovereignty, for which the maiden flight and subsequent ramp-up of Ariane 6 will be instrumental. Climate also remains a major concern for ESA's member states. Earth-observation satellites and programmes like Copernicus are therefore a priority to anticipate and combat climate change. France underlined its strong commitment in this area, upping its contribution to Earth observation by 26%. Another key strategic and economic domain is satellite telecommunications, for which France increased its funding commitments by 70%. In particular, it plans to devote €300 million to the IRIS² European secure connectivity constellation, an important project for Europe's independence and competitiveness.

Human and robotic space exploration remains a prime focus for Europe, and France is pursuing its commitment with a 49% increase in funding. The new class of European astronauts announced at the conference includes two French candidates, Sophie Adenot (career astronaut) and Arnaud Prost (reserve astronaut). Sophie Adenot joins Thomas Pesquet in the ranks of ESA's career astronauts, becoming France's second female astronaut after Claudie Haigneré.
Lastly, Europe also intends to consolidate the pre-eminent place of ESA's mandatory scientific programme in the world order.
ESA's member states stepped up to the plate and affirmed Europe's space ambitions in an increasingly competitive international arena where securing sovereignty is paramount.

"The outcome of this ministerial conference is a testament to our unity and ambition in space. We must join forces and the record levels of funding obtained for Earth observation, telecommunications and space exploration will consolidate our leadership in space. Thanks to the key agreement between France, Germany and Italy on future launchers, this summit has strengthened Europe's independence and sovereignty, boosted the competitiveness of France's space sector and further multiplied the benefits of space to citizens."

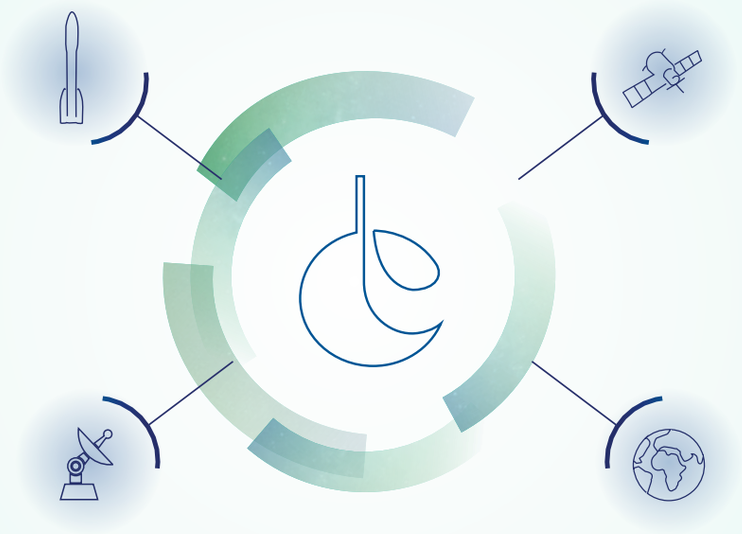
Bruno Le Maire,
Minister of the Economy, Finance and Industrial and Digital Sovereignty.

NEW SPACES

In 2022, the government set the course for the nation's space strategy with the signing by CNES's Chairman & CEO Philippe Baptiste and the agency's three overseeing ministers of the Objectives and Performance Contract (OPC). Under the banner of New Spaces, this new OPC is built around four strategic ambitions for the next three years.

CNES will continue working to support our nation's **SOVEREIGNTY** by maintaining independent access to space for France and Europe, while bolstering our military space power.

We are pursuing our remit to serve **SCIENCE** and leading ambitious missions, extending French scientific excellence worldwide and playing our full part in future space adventures and exploration missions.



We are also striving to boost the French space industry's **ECONOMIC COMPETITIVENESS,** helping the ecosystem's stakeholders to diversify through development of disruptive technologies and by establishing new partnership, service procurement and co-funding models with industry.

And we are making **CLIMATE** science a top priority, maintaining France at the forefront of space and consolidating our commitments, notably through our Earth-observation programmes.

The fast pace of change in the space sector and the newly emerging landscape are also changing the way CNES works, with more subsidiarity, more stakeholders and more agility, while preserving and honing the technical expertise required to stay abreast of these shifts.

FRANCE 2030

FRANCE IN THE VANGUARD OF THE ECONOMIC AND SCIENTIFIC CONQUEST OF SPACE

In 2021, President Emmanuel Macron launched the France 2030 plan to inject €54 billion of government funding over five years. One of this plan's objectives is to consolidate our nation's place in the new space era. With a budget of €1.5 billion, the Space strand of the plan is geared towards making France a world leader and strengthening its strategic independence.

This funding will sustain the momentum of the French New Space ecosystem by positioning France in high-growth markets, investing in disruptive technologies and channelling investments towards users' needs and future high-potential markets.

To accomplish these goals, CNES is working with public investment bank Bpifrance to implement the Space strand of France 2030 on behalf of the government.

As a key player driving this effort, CNES is charged with identifying emerging markets through its Space Observatory, conceiving roadmaps to stimulate innovation and industrial solutions in these fields, and issuing requests for proposals. The agency also surveys the needs of public stakeholders potentially interested in using space data, with a view to obtaining orders for industry contractors.

The first meeting of the interministerial steering committee in charge of the Space strand of France 2030 was held at CNES headquarters in October 2022. The agency's three overseeing ministers—Bruno Le Maire, Sébastien Lecornu and Sylvie Retailleau—presented

the first laureates of the plan's call for projects: a "Micro-launchers" call to develop a sovereign mini- and micro-launcher capability and the required main components; a "Diamant launch pad refurbishment" call to accommodate micro-launcher operators at the Guiana Space Centre; and a "Motorized dispenser" call to develop a system for positioning several satellites at a time into different orbits on a single launch.

Also announced at this meeting:

- A request for proposals led by CNES to exploit satellite data for maritime surveillance
- A call for projects operated by Bpifrance to support development and series production of satellite constellations and their technologies

FRANCE 2030'S AMBITIONS FOR THE FRENCH SPACE SECTOR:

+1
REUSABLE MICRO/ MINI-LAUNCHER WITHIN THE 2026 TIMEFRAME

+10
SERVICES PROVIDED BY OPERATIONAL CONSTELLATIONS BY 2030

+200
PUBLIC AND PRIVATE ENTITIES MAKING USE OF SPACE DATA

BUDGET

Every year, CNES's budget is approved by our board of directors and our accounts are signed off by our auditors and regularly controlled by the Cour des Comptes, France's financial watchdog.

In 2023, the agency's budget has been substantially increased, showing the strong priority given to space and enabling us to maintain the pace of our activities.

2023 BUDGET

€2,598m

SUBSIDY FOR ESA CONTRIBUTION
€1,079m

FRANCE 2030
€84m

NATIONAL PROGRAMME SUBSIDY
€848m

STIMULUS PLAN
€59m

EXTERNAL SOURCES
€507m

PIA FUTURE INVESTMENT PROGRAMME
€21m

WHO FUNDS CNES?

To accomplish its missions, CNES receives funding from multiple sources: public service subsidies, the PIA future investment programme, stimulus plan and France 2030 plan, and from external sources for programmes where we have delegated responsibility (DGA, ESA, Eumetsat, etc.).

COOPERATION & PARTNERSHIPS

GO-TO PARTNER

While space is a highly strategic and commercially competitive arena, it also offers fertile ground for collaboration, especially in science and exploration.

As a pivotal player in space cooperation, CNES intends to pursue and step up foundational collaborations with its European partners and the world's major space powers, as well as with nations nurturing new ambitions in space.

Such collaborations serve the threefold aim of executing the agency's scientific and programmatic priorities, sustaining France's commercial ecosystem in export markets and supporting the nation's broader diplomacy efforts.

As Christophe Venet, CNES's Director of European and International Affairs, underlines, the key is to "strike the right balance between France's contributions to ESA, national initiatives and international partnerships. We're supporting the Ariane 6 and Copernicus projects developed through ESA and the EU, as well as science and exploration projects developed in partnership with NASA, like Perseverance and SWOT."

DIPLOMACY IS THE KEY

International relations are all about diplomacy, and space is no exception. Our space advisors in Brussels, Berlin, Washington D.C., Tokyo, Bangalore, Abu Dhabi and Beijing are constantly seeking to consolidate cooperation with the agency's longstanding partners. Working every day in close contact with their local contacts, they assist France's ambassadors in all matters pertaining to space.

CNES HAS BILATERAL AND MULTILATERAL PARTNERSHIPS WITH

44

COUNTRIES AND INTERNATIONAL ORGANIZATIONS.

90%

OF SPACE MISSIONS CONDUCTED TODAY BY FRANCE ARE WITH EUROPEAN OR INTERNATIONAL PARTNERS.

Philippe Etienne, France's Ambassador to the United States, welcomes NASA Administrator Bill Nelson and Philippe Baptiste at the 2023 New Year wishes ceremony.

SOVEREIGNTY

Space is instrumental in assuring France and Europe's strategic independence. As a key pillar of our national sovereignty, CNES is more than ever gearing up for Ariane 6 operations while laying the groundwork for the launchers of the future. At the same time, we are working more closely with the Ministry of Armed Forces to deploy new space assets and pursue our collaboration with French Space Command.

ARIANE 6

READYING FOR ITS MAIDEN FLIGHT

For the Ariane family, the time has come to hand over the reins to a new generation. In the months ahead, it will be Ariane 6's turn to make its maiden flight from the new ELA-4 launch complex at the Guiana Space Centre, officially opened in the autumn of 2021. The challenges awaiting this new launcher are many. Its mission is to maintain Europe's space launch capability with a totally independent, competitive and versatile system geared to institutional and commercial needs. To ready for the big day, the start of the year will be devoted to the final phases of combined testing to verify all of the interfaces, communications between the launcher and launch pad, flight software and checkout equipment, as well as tank filling and draining operations.

SHORT TAKE

- The Ariane 6 programme has mobilized **4,000 people** from 13 countries
- **Ariane 6 will be cheaper,** with a kilogram-to-orbit price 40% lower than Ariane 5
- With its two A62 and A64 variants, **Ariane 6 will also be more modular,** making it adaptable to all types of mission: medium and heavy lift, constellations, Earth observation, science and geostationary satellites

MICRO/MINI-LAUNCHERS

CNES PICKS UP THE PACE

In December 2021, CNES issued a call for projects to support micro/mini-launcher operators that will round out Europe's range of launchers and launch services at the Guiana Space Centre. A first group of seven start-ups was down-selected in the summer of 2022. Other candidates may join them and the laureates are expected to be announced in 2024. Alongside this effort and with backing from the France 2030 plan, CNES has started work with several local French Guianese firms to adapt the historic Diamant rocket launch pad to future micro/mini-launchers. Work to ready the site will be ongoing throughout 2023.

CALLISTO

REUSABLE DEMONSTRATOR ALL SET FOR LAUNCH

Looking to lower the cost of space transportation, CNES has teamed up with the German and Japanese space agencies DLR and JAXA to explore reusable launchers. The three partners have developed the Callisto demonstrator, a spacecraft standing 15 metres tall and one metre across, designed to flight test and validate the feasibility and business case of a European launcher employing a reusable first stage. The first tests are planned in 2024 at the Diamant site at the Guiana Space Centre. 2023 will be devoted to ground testing of the vehicle's equipment and subsystems, and to final validation of the refurbished Diamant launch zone.

15 metres
TALL

1 metre
ACROSS

ARIANE 5

A LEGENDARY LAUNCHER

In 2023, Ariane 5 will lift off for the last time in its storied 27-year history. Arguably one of the finest symbols of Europe's space programme, the launcher has orbited our sovereign satellites and preserved France and Europe's independent space launch capability. Now, it is handing over this mantle to Ariane 6.

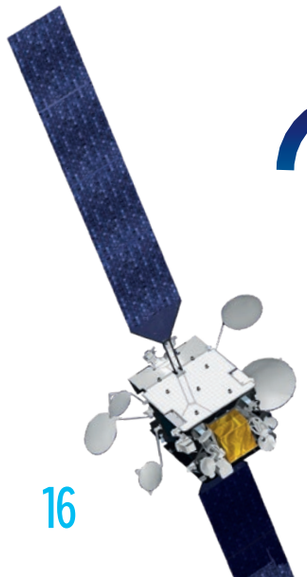
Ariane 5 has also proven itself the world's most reliable launcher, thanks to its design originally tailored to a human spaceflight programme, subsequently shelved. This record reliability—with a launch success rate of more than 95% for the vehicle's four versions—has served the most prestigious passengers, like the Rosetta probe in 2004, the five European ATV resupply spacecraft from 2008 to 2014 and more recently the James Webb Space Telescope in 2021, for which the pinpoint launch has already extended the telescope's service life by five years.

SPACE COMMAND
RAMPING UP IN TOULOUSE

Created in 2019 to orchestrate France's military space strategy, Space Command (CDE) is continuing to ramp up its operations at the Toulouse Space Centre. A key milestone was reached at the end of 2022 with the signing of the construction lease between CNES and the Ministry of Armed Forces for the future CDE building planned to accommodate 500 people in September 2025. A second building to house the NATO Centre of Excellence (COE) for space, able to accommodate 50 permanent French and international staff, will take its place adjacent to the CDE. Several more milestones are planned in 2023, with a new floor for the provisional premises currently occupied by the CDE, a computing centre, training for military operators and of course the start of work on the future facilities. A more sophisticated third AsterX space threat simulation exercise led by the CDE with technical support from CNES was also held in the first quarter of the year.

"We are delighted to be hosting the CDE building at CNES's strategic field centre in Toulouse. I am sure we can look forward to many successes together that will strengthen France's excellence in space and extend the reach of this ecosystem in which shared expertise is essential."

Philippe Baptiste,
CNES Chairman & CEO.

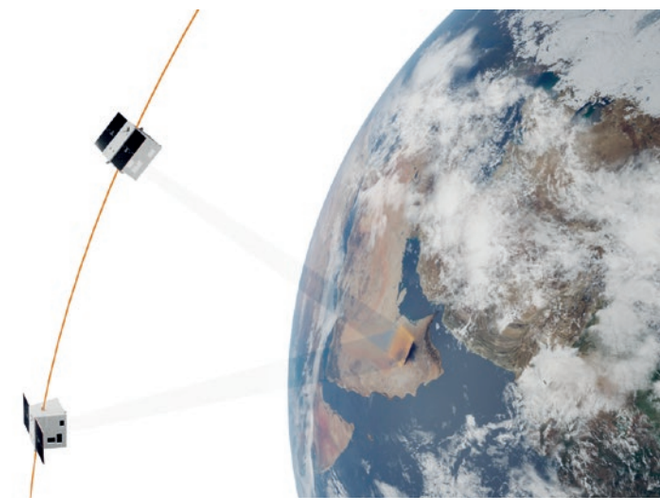


MILITARY COMMUNICATIONS
SYRACUSE 4 TWINS UNITED

In the first half of 2023, Syracuse 4B will be lofted into space by Ariane 5 to join its twin Syracuse 4A in geostationary orbit. Representing the latest generation of France's military communication satellites, these two new additions to the Syracuse family will support secure and high-speed land, air, naval and submarine communications for French armed forces around the globe. With their increased bandwidth, new antenna design and ground control centres, the satellites' innovations offer greater communication capacity, flexibility, security and anti-jamming.

CO3D
MINI-SATELLITES FOR MAX 3D

Developed and built by CNES and Airbus, the CO3D constellation is set to deliver stereoscopic Earth imagery to map land surfaces in 3D at the unrivalled cadence of 25 million sq.km every year at submetric resolution. These data will chiefly meet military users' requirements for precise and responsive terrain mapping. The programme comprises four identical 300-kilogram mini-satellites that will be placed into low Earth orbit on the same flight in the first half of 2024.



RECONNAISSANCE SATELLITES
CSO FAMILY COMPLETE

After the first two satellites orbited in 2018 and 2020, a third and last satellite will be joining France's flagship CSO[1] military space programme by 2024, before the arrival of the next-generation IRIS reconnaissance satellites. Placed in different polar orbits, the three identical CSO satellites serve complementary objectives. CSO-1 acquires very-high-resolution imagery from its 800-kilometre perch for reconnaissance of field operations. Flying lower, CSO-2 offers extremely-high-resolution (EHR) imagery for force identification, while CSO-3 will increase the system's revisit rate.

[1] Composante Spatiale Optique (Optical Space Component)

ECONOMIC COMPETITIVENESS

CNES's mission is to harness the full potential of space to drive economic growth and industrial competitiveness. In a landscape transformed by the rise of New Space where getting into space is now easier than ever before, the agency's role is to help France's world-class space ecosystem to adapt and keep pace with new trends, while nurturing increasingly innovative applications. As the longstanding partner of French industry, we are today stepping up our support to all areas of the private sector.

KINEIS CONSTELLATION

THE FUTURE OF CONNECTED DEVICES TAKING SHAPE

€100m

TO DEVELOP, BUILD AND LAUNCH A CONSTELLATION OF

25

NANOSATELLITES

Formed in 2018 by CNES and CLS to operate the Argos system, start-up Kineis completed the following year a historic funding round of €100 million to develop, build and launch a constellation of 25 nanosatellites dedicated to the Internet of Things (IoT). Built by Hemeria and Thales Alenia Space around the ANGELS prototype developed by Hemeria with CNES, the Kineis nanosatellites will be orbited by five dedicated missions, the first of which is scheduled in the months ahead. They will connect millions of devices in domains such as agriculture, logistics, transport and energy.

In addition to providing IoT connectivity, the future constellation will augment the Argos system with a new generation of instruments capable of receiving AIS[1] signals for ship tracking. CNES is closely involved in this project, contributing its expertise to technology development and assisting in the constellation's deployment.

[1]Automatic Identification System

U-SPACE
A CNES SUCCESS STORY

CNES and U-Space's relationship formed at a very early stage, even before the Toulouse-based start-up was incorporated, since its three founders met through the agency's EyeSat student nanosatellite project.
A few years on, business for the fledgling firm is looking good after a recently completed funding round of €7 million and the success story with CNES is continuing with two new major projects: the imminent launch of NESS, a demonstrator satellite to monitor the radiofrequency spectrum around the globe, and the Synchrocube programme. Developed with three other New Space start-ups and funded by CNES through the government's stimulus plan, Synchrocube aims to complement GNSS[2] navigation systems by providing synchronization when signals are unusable. The first nanosatellite in the Synchrocube series is planned for launch within the 2024 timeframe.

[2]Global Navigation Satellite System

NESS nanosatellite.

KONNECT VHTS
A COLOSSUS TO BRIDGE THE DIGITAL DIVIDE

On 7 September 2022, Ariane 5 orbited Eutelsat's new-generation KONNECT VHTS satellite built by prime contractor Thales Alenia Space around its all-electric Spacebus Neo spacecraft bus. With 230 spot beams over Western Europe and a capacity of 500 Gbps, KONNECT VHTS is the most powerful geostationary satellite ever built in Europe. Once on orbit and after several months of testing, this 6,500-kilogram giant —8.4 metres tall in its final configuration—will provide fast-broadband Internet access all over Europe, particularly to currently underserved regions or "notspots", offering a service comparable to fibre-optic networks in terms of performance and cost. The distinguishing feature of KONNECT VHTS is its payload incorporating high-capacity Q-band and V-band feeder links, which drew on developments from the THD-SAT project funded by the government's PIA future investment programme, and a core built around an ultra-high-performance digital processor developed under CNES's R&D programmes, affording agile capacity allocation, optimal spectrum usage and progressive deployment of network coverage on the ground. The telecom portion of the KONNECT VHTS system's ground segment, set for delivery at the end of 2024, will also be 100% French-built, notably comprising consumer terminals designed, developed and manufactured in France under a project funded by CNES through the national space stimulus plan.

> **The European Commission is already gearing up for future services that will rely on this RLS function and enable new features such as remote activation of aircraft emergency locator beacons or SMS-type two-way communication between rescue centres and users in distress. Full-scale demonstrations were conducted in 2022 under European research projects to prepare for the arrival of these new services."**
>
> **Sylvain Delattre,** SAR/Galileo project leader.

COSPAS-SARSAT
GNSS SATELLITES TO THE RESCUE

In 40 years, the COSPAS-SARSAT system has saved thousands of lives at sea, on land and in the air, detecting and locating signals from distress beacons with ever more precision and speed.

For its first three decades, this international search-and-rescue (SAR) programme federating 39 countries relied on a two-tier system consisting of geostationary satellites (GEOSAR) and low Earth orbit satellites (LEOSAR). Since 2014, it has gradually added another intermediate tier with repeaters on GNSS satellites, particularly the Galileo constellation. Between now and 2024, this MEOSAR system will be ramping up to full operational capacity, offering the advantages of the LEOSAR and GEOSAR systems but without their limitations, by enabling transmission of distress messages and independent beacon location all over the globe in near-real time.

Since 2020, another feature called Return Link Service (RLS), provided thanks to Galileo, is also fully operational. With RLS, users in distress anywhere in the world receive confirmation within minutes that their distress call has been picked up and located.

The Space strand of the France 2030 plan will support the growth of the New Space ecosystem, without excluding established players. On the contrary, it will encourage cooperation across the board. It's also resolutely geared towards users and future growth markets by developing procurement of services."

Jean-Marc Astorg,
CNES Director of Strategy.

SPACELY
A CLUB TO BOOST INVESTMENT IN SPACE

Spacely is a club formed in the autumn of 2022, dedicated to public and private investors. Seeking to ease access to funding for firms in the space ecosystem, Spacely will give investors direct access to high-potential space businesses, while giving them the benefit of the strategic vision of the sector's evolution that CNES and its partners can provide. A first Spacely event on the theme of "space and automotive" was held in January 2023.

NEXT
ANTICIPATION AND DISRUPTION

To step up New Space momentum, Connect by CNES has created a new structure called NEXT. Its aim is to anticipate shifts and disruptive developments in the space sector, while nurturing new players or helping existing firms to grow in future high-potential markets. A first challenge focused on sustainable space with a budget of €400,000 was organized through NEXT in the autumn of 2022.

TECHTHEMOON
SECOND COHORT READY TO FLY

Conceived in 2021 from the collaboration between start-up incubator Nubbo and CNES, TechTheMoon is the world's first incubator dedicated exclusively to the lunar economy. Every year, it offers technical support, human resources and funding for 12 months to help a handful of entrepreneurs develop innovative solutions geared towards establishing a permanent human presence on the Moon. All products and services developed by TechTheMoon must also be able to be spun off on Earth. Five new start-ups were selected in the autumn of 2022 and will be pitching their projects to investors and mentors in September 2023.

SPACEFOUNDERS
A NEW SPACE ACCELERATOR

SpaceFounders is a European accelerator created in 2021, co-funded and co-operated by CNES and Bundeswehr University Munich (UniBw). It offers access to a vast network of mentors and investors, as well as a free three-month crash course to prepare start-ups to seek funding and execute their growth strategy. SpaceFounders is open to all European start-ups operating in all sectors of the space industry that have already completed a round of funding. It has so far lent its support to 20 start-ups and invested in two of them at the end of 2022. A new cohort was selected at the start of 2023.

Start-up Zephalto received support from the SpaceFounders accelerator.

Studying, understanding and exploring the universe have forever posed huge challenges, no more so as we contemplate establishing a permanent human presence on the Moon and potentially Mars. The science missions that CNES is pursuing through ESA and with other international space agencies are instrumental in projecting French space science on the world stage and vital to advancing research.

JUICE

INVESTIGATING JUPITER'S ICY MOONS

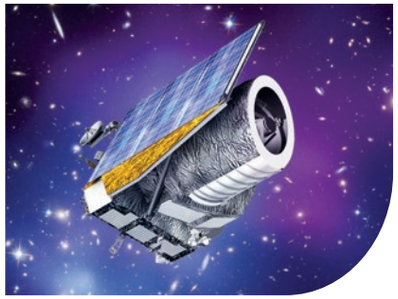
In April 2023, Ariane 5 will be sending the JUICE spacecraft on its way to join NASA's Juno orbiter. After a eight-year journey, JUICE will observe Jupiter and its three large icy moons Ganymede, Callisto and Europa for three years.

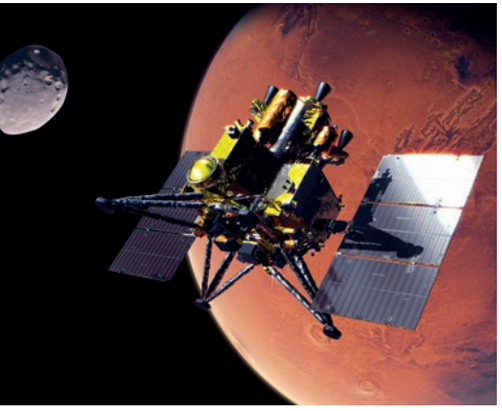
The main challenge for this ESA-led mission is to determine whether the Jovian satellites' subsurface oceans contain traces of life and thus to gain new insights into the origin of the universe and formation of planets. CNES is supporting seven French research laboratories working to develop JUICE's scientific instruments, including the MAJIS imaging spectrometer.

EUCLID

UNRAVELLING THE MYSTERY OF DARK ENERGY

Why is the universe expanding at an accelerating rate? Europe's Euclid space telescope will be departing Earth in 2023 in an attempt to find some answers to this question. Its mission is to map several hundred million galaxies in three dimensions to try to solve the mystery of the dark energy that bends the light they emit and could be what is driving the accelerating expansion. To accomplish this titanic task, Euclid will rely on two main instruments: the visible instrument (VIS) and the Near Infrared Spectro-Photometer (NISP), whose development was led in partnership with the French scientific community by CNES, which is also responsible for the mission's ground segment.





MMX

DELVING INTO THE PAST OF MARS' MOONS

In 2024, the Japan Aerospace Exploration Agency (JAXA) will be launching its Martian Moons eXploration (MMX) mission to Phobos and Deimos, Mars' two moons, to probe their past. The spacecraft will perform detailed observations of the two natural satellites, study Mars' climate and collect samples from the surface of Phobos for a return to Earth in 2030. In 2023, CNES will be delivering the flight models of two of the mission's eight instruments: the MIRS infrared mapping spectrometer, which will be on the spacecraft, and the Idefix rover developed with the German space agency DLR. This small rover will be set down on Phobos to scout its surface and characterize the soil before MMX collects samples.

SVOM

OBSERVING BLASTS FROM THE PAST

The result of a longstanding collaboration between the China National Space Administration (CNSA) and CNES, the SVOM astronomy mission will seek to observe gamma-ray bursts (GRBs) generated by the explosion of massive stars or the merger of extremely compact objects like neutron stars and black holes. Studying GRBs from very distant and therefore very old galaxies could provide precious clues to how our universe evolved. SVOM is planned to launch in 2023 from China's Xichang launch base with two French-designed instruments. The first is the ECLAIRs telescope that will alert the satellite to GRBs and determine their celestial location in order to point the satellite at them. The second is the MXT telescope that will provide much more precise coordinates of GRBs to the optical imaging telescope. CNES will also be operating a network of VHF antennas to send data to the ground segment instruments observing GRBs from Earth.

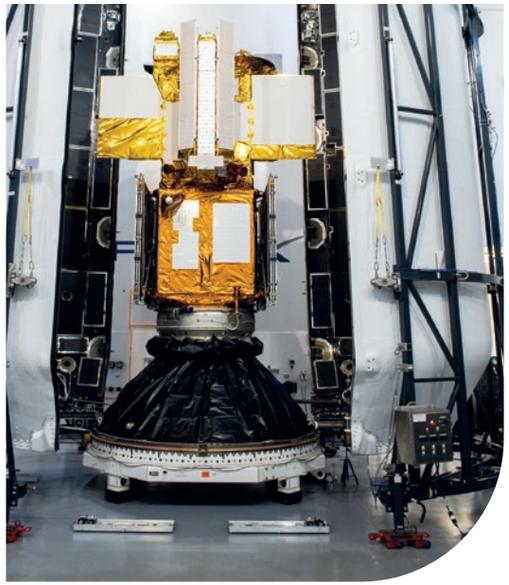
> **The light from gamma-ray bursts will take us back in time to the origins of the universe."**
>
> **François Gonzalez,** SVOM project leader.

The threats looming over our environment and the over-exploitation of natural resources call for a global sustainable development strategy. As a climate-driven space agency with an ambitious corporate social responsibility strategy, CNES is stepping up its efforts to tackle global warming. Our agency's renowned expertise in Earth observation means France is in the vanguard of this effort in Europe and around the globe.

SWOT

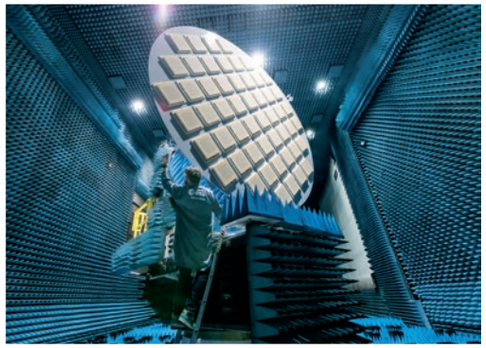
SHEDDING NEW LIGHT ON PLANET WATER

Eagerly awaited by the world's hydrologists and oceanographers alike, the French-U.S. SWOT (Surface Water and Ocean Topography) satellite was launched in December 2022, carrying the revolutionary KaRIn wide-swath radar interferometry instrument that will enable them to study the topography of oceans, rivers and lakes in unprecedented detail. With its radiofrequency core developed by Thales Alenia Space for CNES and NASA, this innovative instrument will acquire vital information about large-scale hydrological mechanisms such as variations in river discharge and levels of lakes and retention basins that previous-generation radar altimeters couldn't see. After in-orbit commissioning planned in the first half of 2023 and a calibration/validation phase, SWOT will be ready to enter operational service in the summer.



This pioneering mission will be the first to conduct a systematic global survey of Earth's water, marking a giant leap towards managing this resource more efficiently. It holds out a lot of potential for our space industry as well as for future users of its data."

Thierry Lafon, SWOT project leader.



BIOMASS
EYE ON THE WORLD'S FORESTS

With the effects of a changing climate growing ever more intense, the issue of carbon sequestration by forests is coming into sharper relief. But just how much capacity does our planet have left to store it? How much longer can Earth's "green lungs" continue regulating the carbon cycle? These are questions the Biomass mission will be seeking to answer in 2023. This seventh mission of ESA's Earth Explorer programme conceived by the CESBIO biosphere space research centre in partnership with CNES will be tasked with mapping biomass of the world's forests in order to precisely track how much carbon is being stored there. Thanks to its synthetic aperture radar (SAR), Biomass will notably deliver data to generate 3D forest models and gain new insights into the topography of dense tropical rainforests, which remains largely unknown. The mission will also tell us more about open landscapes like deserts.

SCO
SPACE SERVING REGIONAL RESILIENCE

Formed in 2019 under the impetus of CNES, the Space for Climate Observatory (SCO) is an international initiative pursued by 36 members—space agencies, international bodies and scientific community representatives—committed to developing operational tools together using space data to strengthen regions' resilience to the impacts of climate change. Each national branch of the SCO is tasked with boosting development of local projects with a view to replicating them elsewhere. SCO France has so far lent its support to 51 projects, spanning a range of areas from decision support for creating green spaces to flood prevention. It will be marking an important milestone in its young history in May 2023 when it holds its second national congress.

BALLOONS
BACK ON THE CAMPAIGN TRAIL

For nearly six decades, CNES balloons have been scouring the skies to study the atmosphere at altitudes up to 40 kilometres. Three new survey campaigns are scheduled between now and 2025. In August 2023, four stratospheric zero-pressure balloons (ZPB) will be lofted skywards from the Timmins base in Canada to conduct 16 scientific experiments for the Strato-Science programme. The following year, further ZPB flights will be launched from Kiruna in Sweden, one of them possibly transatlantic. A new Strateole-2 campaign involving a flotilla of 20 atmospheric superpressure balloons is also planned for the end of 2025 to continue studying exchanges between the upper troposphere and equatorial lower stratosphere.

MICROCARB

MAPPING CARBON SINKS AND SOURCES

The environmental consequences of CO_2 emissions are well known, but the absence of ground measuring stations in many regions of the globe means scientists still lack data on CO_2 concentrations in the atmosphere. CNES will be orbiting the MicroCarb mission in 2024 precisely to fill this gap.

Funded through the government's PIA future investment programme, this microsatellite will be built around a CNES Myriade spacecraft bus. It will be equipped with a dispersive grating spectrometer able to map all sinks and sources of CO_2—vegetation, oceans, cities, etc.—by measuring the total column concentration with unprecedented precision (on the order of 1 ppm).

IASI-NG

A PROMISING SPECTROMETER FOR METEOROLOGISTS

In the spring of 2022, Airbus Defence & Space and CNES presented IASI-NG, an infrared sounding interferometer designed to fly on the next-generation Metop family of weather satellites developed by ESA and Eumetsat. This new instrument succeeds the IASI series, offering a twofold increase in spectral resolution and signal for greater precision in measuring temperature and humidity. By 2024, three flight models of IASI-NG will be delivered to ESA for integration with the Metop-SG satellites, the first launch of which is planned early in 2025.

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TIMES MORE
SPECTRAL RESOLUTION AND INSTRUMENT SIGNAL

AOS

PROGRAMME OF THE DECADE FOR ATMOSPHERIC SCIENCE

Initiated by NASA, the Atmospheric Observing System mission (AOS) is set to supply crucial data on aerosols, clouds and precipitation for improving climate models and weather forecasting.

France, via CNES, expects to be contributing to this mission alongside the Japanese, Canadian and German space agencies with the supply of two instruments scheduled to launch on AOS satellites between 2028 and 2030. France's participation in this programme is a key element of CNES's continuing cooperation efforts.

UPCOMING EVENTS

54TH PARIS AIR SHOW SETS SIGHTS ON THE FUTURE

After a four-year hiatus due to the COVID-19 pandemic, the 54th International Paris Air Show will be opening its doors at Le Bourget from 19 June 2023 under the banner of innovation, discussions and passion. This is a must-attend event for CNES, which will be present as it has been from the outset to showcase its activities, share its expertise, officially announce new partnerships and of course spur vocations. Throughout the week, the agency will be hosting trade visitors and the general public in its specially designed pavilion, coordinated this year with ESA's inside a shared exhibition area. Visitors will notably be able to discover the five finalists from secondary schools in CNES's Launch the Future competition initiated in the spring of 2022, with projects focusing on themes like zero-carbon launchers and de-orbiting of space debris.

19 to 25 June 2023 – Paris-Le Bourget exhibition centre

CNES KEY EVENT CALENDAR

JULY 2023

60 years of C'Space

Organized by CNES and non-profit association Planète Sciences, C'Space is the yearly get-together for student space projects. Rocket and CanSat launches are centre stage at the week-long event attended by students and professionals from different horizons and cultures. This year it will be celebrating its 60th anniversary.

Camp de Ger military base - 15 to 22 July 2023

OCT 2023

74th International Astronautical Congress (IAC)

The next IAC on the theme of Global Challenges and Opportunities: Give Space a Chance is an event not to be missed that will be attracting a large gathering of international space stakeholders from agencies, industry and the scientific community.

Baku, Azerbaijan - 2 to 6 October 2023

EARLY 2024

Opening of new Space Museum

In 2022, the Space Museum at the CSG closed its doors for a refurbishment funded by the European Union, CNES and ESA. The enlarged museum has been given a complete facelift and above all has been transformed into a fun and interactive experience for visitors.

Guiana Space Centre (CSG), Kourou

JULY 2024

45th Scientific Assembly of COSPAR

The Committee on Space Research (COSPAR) is an international organization charged with promoting space research and advancing science and engineering, focused on sharing results, information and opinions. Its Scientific Assembly convenes every two years to offer a forum for scientists everywhere.

Busan, South Korea - 13 to 21 July 2024

OCT 2024

CNES Science Survey Seminar

In its role stimulating French space science research, CNES organizes a Science Survey Seminar every five years, giving the scientific community the opportunity to come together and help chart the course of the nation's space science programmes. This survey task is vital to map out a vision beyond the horizon of projects currently underway.

Saint-Malo - 8 to 10 October 2024

CNES CENTRES

To execute the nation's space policy, CNES relies on strong shared values like excellence, enthusiasm and the desire to rise to the challenges that lie ahead. Our agency's 2,360 men and women are striving every day to guarantee our nation's scientific and operational excellence, to make the French space ecosystem more competitive and to ready for the future.

OUR 4 CENTRES OF EXCELLENCE

ARE HELPING TO PROJECT FRENCH SPACE POLICY

Paris Les Halles - Space policy

Our experts at CNES Head Office fulfil two key missions: map out French space policy and craft and coordinate CNES's national, European and international programmes. Every year, CNES signs dozens of multilateral agreements, laying the foundation for new science and technology partnerships. The agency works with industrial, business, military, scientific and academic partners in France.

Head Office,
2, place Maurice Quentin,
75039 Paris Cedex 01
Tel.: +33 (0)1 44 76 75 00

Toulouse Space Centre - Orbital systems

Our engineers in Toulouse conceive, design, develop, build, position, control and operate orbital systems. Their work also involves encouraging uptake of satellite data for the benefit of all and innovating and creating to imagine tomorrow's space systems. With nearly 3,000 space people working on site, the Toulouse Space Centre (CST) is the largest space field centre in Europe.

Toulouse Space Centre,
18 avenue Edouard Belin,
31401 Toulouse Cedex 9
Tel.: +33 (0)5 61 27 31 31

Paris Daumesnil - Future launch systems

The one thing teams at our Paris Daumesnil facility all share is a focus on space transportation. Within its various directorates, our experts are working to advance future projects like reusability, advanced propulsion concepts, in-orbit servicing systems or human spaceflight. Most of them come under the Space Transportation Directorate (DTS) and are helping to develop Europe's launch systems, notably as prime contractor for Ariane 6 ground support systems and providing launcher oversight assistance for ESA-STS (Space Transportation System).

Paris Daumesnil,
52, rue Jacques Hillairet,
75612 Paris Cedex
Tel.: +33 (0)1 80 97 71 11

Guiana Space Centre - Launch operations

The Guiana Space Centre (CSG) offers exceptional conditions for launching all types of satellites into all orbits. Europe's spaceport guarantees independent access to space for ESA's member states. Its 1,600 personnel—including 270 CNES employees—from 40 European companies conduct launch preparations and operations. With its modern facilities and two operational vehicles, the CSG is the chief asset of Europe's space strategy and gearing up for the energy transition.

Guiana Space Centre,
BP 726, 97387 Kourou Cedex
Tel.: + 594 (0)5 94 33 51 11

CNESfrance @CNES CNES

March 2023 – **Organizations:** Airbus DS - French Embassy to the United States - CNES - ESA - ESA, the Hubble Heritage Team - JAXA - Mira Productions - NASA/ESA/CSA/STScI - NASA, USSF 30th Space Wing - PRODIGIMA - SNSM - Thales Alenia Space. **Photographers:** Stéphane Corvaja - Joshua Duff - Romain Gaboriaud - Emmanuel Grimault - Rodrigue Laurent - Frédéric Lancelot - Christophe Peus - Manuel Pedoussaut - Hervé Piraud - Thierry de Prada - CSG photo and video department / Jean-Michel Guillon / Philippe Baudon / Sandrine Martin. **Illustrators:** Présence - Éric Briot - David Ducros - ESA/ATG medialab - ESA-SJM Photography - Œil du Chat - Rémi Parot - Michel Regy - Oliver Sattler - Zephalto. **Copywriting:** Dominique Fidel and Audrey Decrock. **Design and production:** WAT- agencewat.com **Artwork:** CNES Photo Library, Photon, Orianne Arnould, Marie-Claire Fontebasso. **Printing:** Escourbiac. **Translation:** Boyd Vincent. **Published by:** CNES Communication Directorate.

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